

IAF Space Propulsion Symposium

Held at the 74th International Astronautical Congress
(IAC 2023)

Baku, Azerbaijan
2 - 6 October 2023

Volume 1 of 2

ISBN: 978-1-7138-8560-3

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2023) by International Astronautical Federation
All rights reserved.

Printed with permission by Curran Associates, Inc. (2024)

For permission requests, please contact International Astronautical Federation
at the address below.

International Astronautical Federation
100 Avenue de Suffren
75015 Paris
France

Phone: +33 1 45 67 42 60

Fax: +33 1 42 73 21 20

www.iafastro.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

LIQUID PROPULSION (1)

KEYNOTE: OVERVIEW ON DEVELOPMENT OF LIQUID ROCKET ENGINES FOR HEAVY LAUNCH VEHICLES IN CHINA	1
<i>Yushan Gao</i>	
ADDITIVE MANUFACTURED FUEL INJECTOR AS A WAY FORWARD TO IMPROVE GREEN PROPELLANT LIQUID APOGEE ENGINE	10
<i>Adrian Parzybut, Pawel Surmacz, Zbigniew Gut, Michal Ranachowski</i>	
DEVELOPMENT OF SMALL ROCKET ENGINE FOR ROCKET VENTURES	16
<i>Ryoma Yamashiro, Takao Munenaga, Yoshio Nunome, Hiromitsu Kakudo, Kazuki Sakaki, Ryuichiro Kanai</i>	
DEVELOPMENT OF THE LIQUID OXYGEN AND METHANE M10 ROCKET ENGINE FOR THE VEGA-E UPPER STAGE.....	20
<i>Simone Porzi, Daniele Liuzzi, Rudnykh Mikhail, Caggiano Giuseppe, Arione Luigi, Nicola Ierardo, Adriana Sirbi Paragina, Chiara Boffa, Daniele Kajon, Matteo Sciarra, Giacomo Bianchi, Gianluca Sdoga, Gianluca Martire, Marco Leonardi, Francesco Di Matteo, Sebastien Marcel, Marco De Rosa</i>	
T(H)RUST: APPLIED RESEARCH ACTIVITIES ON LIQUID ROCKET PROPULSION AT SAPIENZA UNIVERSITY OF ROME.....	31
<i>Francesco Nasuti, Daniele Bianchi, Mario Tindaro Migliorino, Marco Grossi, Matteo Fiore, Marco Rotondi, Paolo Maria Zolla, Beatrice Latini, Marco Fabiani, Gianluca Cocirla, Alessio Sereno, Alessandro Montanari, Vincenzo Barbato</i>	
INVESTIGATION ON PERFORMANCE IMPROVEMENT OF THE NEW HYDROGEN PEROXIDE THRUSTER WITH EXTERNALLY HEATED AEROSPIKE NOZZLE	42
<i>Kotaro Munenaga, Masanori Harada, Hideki Moriai</i>	
DEVELOPMENT OF PROPULSION SYSTEM FOR CHINA CHANG'E 5 LUNAR PROBE	50
<i>Xin Hong</i>	
OVERVIEW OF EQUIPMENT AND SUBASSEMBLIES FOR THE ESM PROPULSION SYSTEM FOR ARTEMIS MOON EXPLORATION PROGRAM	62
<i>Dimitri Telitschkin, Michael Biehler, Mohamad El Atrach, Stefan Lentz, Thomas Maier, Martin Riehle, Stefan Ziegenhagen, Timo Krone, Eric Chocheyras</i>	
QUALIFICATION TEST RESULTS OF LE-9 ENGINE FOR H3 LAUNCH VEHICLE	71
<i>Hideto Kawashima</i>	
RESEARCH ON FAULT DIAGNOSIS TECHNOLOGY OF DEEP SPACE PROBE PROPULSION SYSTEM HEALTH DETECTION PROTOTYPE	77
<i>Shuting Wang, Feng Zhang</i>	

LIQUID PROPULSION (2)

QUALIFICATION OF A PROPULSION SYSTEM FOR ACTIVE DEORBIT.....	82
<i>Ulrich Gotzig, Mohamad El Atrach, Ebru Zaccaria, Dirk Busmann, Michael Vorel</i>	
PERFORMANCE EVALUATION OF HYPERGOLIC IONIC LIQUID-BASED FUEL (ILETHCU01) WITH 95% HYDROGEN PEROXIDE OXIDIZER IN 50 N THRUSTER.....	98
<i>Vikas Bhosale, Keonwoong Lee, Wonjae Yoon, Hosung Yoon</i>	
EXPERIMENTAL INVESTIGATION OF FUEL TRANSVERSE INJECTION DURING THROTTLING IN A BIPROPELLANT THRUSTER.	105
<i>Vincent Ugolini, Seungho Lee, Sejin Kwon</i>	
EMPLOYING CARBON-SPLIT PORE TUBES AS ADSORBENTS TO CONTROL THE LEAKAGE OF METHANE IN TRANSPORT VALVES	111
<i>Anagha Udupa, R Tharunika, Akash Prasanna, Syed Muzzammil, Ronit Singh, Shaifali Arora</i>	
SOFT FLOW METER FOR MISSION-ONBOARD TO MEASURE FLOW PARAMETER FOR LIQUID ROCKET ENGINES	112
<i>Elayaperumal Ezhilrajan</i>	
DESIGN AND ANALYSIS OF A NOVEL SWIRL-PINTLE COMBINED FUEL INJECTOR FOR IMPROVED PERFORMANCE OF LIQUID ROCKET ENGINES	119
<i>Sriram Kumar, Parakh Chandra Mridul, Bharath Srinivas S, Saravanakumar R, Vignesh L</i>	
FEASIBILITY OF UV INDUCED DECOMPOSITION OF HIGH TEST PEROXIDE IN SPACECRAFT PROPULSION.....	134
<i>Damian Grabowski, Mateusz Surma</i>	
PERFORMANCE TESTING OF IN HYDROGEN PEROXIDE THRUSTER AT FOTEC PROPULSION TEST FACILITIES	143
<i>Varun Reddy Nandyala</i>	
CONVECTIVE AND RADIATIVE WALL HEAT TRANSFER EVALUATION IN FILM- COOLED LIQUID ROCKET THRUST CHAMBERS	144
<i>Mario Tindaro Migliorino, Gianluca Cocirla, Marco Fabiani, Marco Grossi, Daniele Bianchi, Francesco Nasuti</i>	

SOLID AND HYBRID PROPULSION (1)

PASSIVATION OF ALUMINIUM PARTICLE AND ITS EFFECTS IN SOLID PROPELLANTS: A REAXFF STUDY.....	158
<i>Rene Gonçalves, José Rocco, Leopoldo Rocco, Bruno Rocco</i>	
A CONCEPTUAL DESIGN OF PERMEABLE NOZZLE FOR ALTITUDE COMPENSATION AND THRUST VECTORING	162
<i>Ye Wang</i>	
DESIGN, MANUFACTURING AND TESTING OF 50 MM SOLID ROCKET MOTOR USING NON-HTPB COMPOSITE PROPELLANT FOR POTENTIAL IN-ORBIT APPLICATIONS.....	170
<i>Florin Mingireanu</i>	

EFFECT OF ALUMINUM CONTENT ON NOZZLE EROSION IN A HYBRID ROCKET MOTOR.....	171
<i>Xianzhu Jiang, Hui Tian, Jingfei Gao</i>	
HYBRID AUTOPHAGE PROPULSION FOR SPACE LAUNCH VEHICLES: A PROMISING CONCEPT.....	172
<i>Martin Gros, Marius Celette, Dylan De Lima Viana</i>	
RESEARCH ON ANALYTICAL INVERSE KINEMATICS ALGORITHM FOR SERVO MECHANISM OF SWINGING NOZZLE.....	186
<i>Yuhai Ma, Guanchao Han</i>	
IN-SITU PROPELLANT DESIGN FOR MOON AND MARS EXPLORATION USING HYBRID ROCKETS.....	194
<i>Hessa Almarzooqi, Ozan Kara</i>	
SURROGATE NEURAL NETWORK MODEL FOR INTEGRATED ASCENT TRAJECTORY OPTIMIZATION OF THROTTLEABLE HYBRID ROCKETS.....	203
<i>Paolo Maria Zolla, Alessandro Zavoli, Mario Tindaro Migliorino, Daniele Bianchi</i>	
DESIGN AND TESTING OF THE COMBUSTION CHAMBER OF A H ₂ O ₂ /ABS STUDENT-DEVELOPED HYBRID ROCKET ENGINE.....	219
<i>Giuseppe Oliva, Daniel Cantos Gálvez, Pietro Mondino, Gaston Champagne, Lisa Buxton, Raquel Arrontes Quiroga, Giulio Pelenghi</i>	
COURSE AND CHALLENGES OF FLIGHT QUALIFICATION TEST CAMPAIGN OF THE STUDENTS' HYBRID ROCKET ENGINE.....	234
<i>Marek Dzik, Bartosz Hyzy, Damian Legutko, Pavel Chernenko, Alicja Kwitek, Jakub Czerniej</i>	
 <u>SOLID AND HYBRID PROPULSION (2)</u>	
THERMOPLASTIC SOLID PROPELLANT ANALYSIS.....	250
<i>Ana Carolina Buzelim Dos Santos, José Eduardo Mautone Barros</i>	
STUDY OF THE INFLUENCE OF THE ELECTRIC FIELD ON THE INCIDENTAL IGNITION OF ALUMINIZED COMPOUND SOLID PROPELLANT VIA ELECTROSTATIC DISCHARGE.....	251
<i>Rene Gonçalves, Jorge Fernando Monteiro Jr, José Rocco, Leopoldo Rocco, Bruno Rocco</i>	
MEASUREMENT OF SOLID FUEL PORT PRESSURE BY USING EXPOSED HDPE HYDROGEN PEROXIDE CATALYTIC DECOMPOSITION HYBRID THRUSTER.....	257
<i>Seungho Lee, Junyeong Jeong, Eun Sang Jung, Sejin Kwon</i>	
INVESTIGATION OF THE INFLUENCE OF GAS PHASE MOLECULAR MASS VARIATIONS ON HYBRID ROCKET REGRESSION RATE.....	261
<i>Alessandro Rampazzo, Francesco Barato, Daniele Pavarin</i>	
COMBUSTION CHARACTERISTICS OF AXIAL-INJECTION END-BURNING HYBRID ROCKETS USING LIQUID OXYGEN.....	273
<i>Kaii Ri, Sho Suzuki, Keisuke Minami, Taejun Son, Mai Fukada, Landon Kamps, Masashi Wakita, Harunori Nagata</i>	
EXPERIMENTAL AND NUMERICAL ASSESSMENT OF REGRESSION RATE AND PROPULSIVE PERFORMANCE OF 10N-CLASS HYBRID ROCKETS FOR NANOSATELLITE MANEUVERING.....	280
<i>Stefano Mungiguerra, Sergio Cassese, Riccardo Guida, Raffaele Savino</i>	

ABLATION RESISTANCE ASSESSMENT OF GRAPHITE AND CARBON-CARBON COMPOSITES UNDER HYBRID PROPELLANT ROCKET FREE-JET EXPOSURE	292
<i>Serhan Enes Kalmis, Mustafa Baysal, Baris Emre Kiral, Büsra Kahraman, Mehmet Can Uçar, Arif Karabeyoglu</i>	
NOVEL DESIGN OF GAS GENERATOR SYSTEM USING HYBRID ROCKET MOTOR	298
<i>Mehmet Resat Ufuk, Berkay Terzi, Mehmet Kahraman, Arif Karabeyoglu</i>	
DEMONSTRATION OF CENTRIFUGAL CASTED PARAFFIN WAX-BASED HYPERGOLIC SOLID FUEL FOR HYDROGEN PEROXIDE	300
<i>Junyeong Jeong, Hyeonjun Im, Sejin Kwon</i>	
DEVELOPMENT OF HYBRID THRUSTER IGNITION SYSTEM WITH LOW-TOXICITY FUEL AND CATALYTIC REACTION	304
<i>Yuji Saito, Alejandro Taiki Padilla Torres, Ikeda Hirohide, Taiichi Nagata, Yoshiki Matsuura, Shinji Igarashi, Hironori Chiba, Kosuke Kida, Toshinori Kuwahara</i>	

ELECTRIC PROPULSION (1)

NUMERICAL SIMULATIONS OF THE HELICAL PLASMA THRUSTER EXPERIMENT UNDER DIFFERENT MAGNETIC CONFIGURATIONS	311
<i>Renan Almeida, Rodrigo Andrés Miranda</i>	
ENHANCING IONIC THRUST GENERATION VIA NUCLEAR POWER	315
<i>Pratik B Matt, Krush Machhi, Krish Dhankar, Vageesha Sharma, Syed Muzzammil</i>	
INVESTIGATION ON THE IONIZATION PROBABILITY OF COATED INTAKES USED FOR A NOVEL PASSIVELY IONIZING AIR-BREATHING ELECTRIC PROPULSION CONCEPT FOR VERY LOW EARTH ORBITS	316
<i>Florian Prochnow, Jan-Philipp Wulfkühler, Martin Tajmar, Benson Chun Pang Law, Georgios Kokkinos, Martin Sparkes, William O'Neill</i>	
RESULTS OF THE SUCCESSFUL 48000 H ENDURANCE TEST OF A FEED MULTI-EMITTER	328
<i>Nembo Buldrini, Laura Bettiol, Bernhard Seifert, Florin Plesescu, Jose Gonzalez Del Amo, Luca Massotti</i>	
PULSED PLASMA THRUSTER FOR DEEP SPACE EXPLORATION	336
<i>Jayakumar Venkatesan, Jayaraman Kandasamy, Sudarshan Patilkulkarni, Mirvari Alimova</i>	
COUPLING TEST OF PROPULSION SUB-SYSTEM : TMA 5000, PPU ELEKTRO, AND XFC PPS®5000	337
<i>Alexandre Briges, Vincent Guyon, Julien Rabin</i>	
PPSX00 HALL THRUSTER: ON THE FINAL PATH TOWARDS THE QUALIFICATION OF A SUBKILOWATT-CLASS THRUSTER	340
<i>Claude-Martin Brito, Valentin Quesnel, Vanessa Vial</i>	
STARTING MODES OF MULTIDIRECTIONAL PLASMA THRUSTER OPERATED IN NOBLE GASES	341
<i>Andrei Shumeiko, Victor Telekh</i>	
COUPLED PARTICLE-IN-CELL AND DIRECT-SIMULATION MONTE-CARLO MODELLING OF GRID EROSION BY ION BOMBARDMENT IN RADIO-FREQUENCY ION THRUSTER GRIDS	350
<i>Maximilian Maigler</i>	

MODELLING AND DESIGN OF EARTH AND MARS ATMOSPHERE-BREATHING ELECTRIC PROPULSION SYSTEMS (ABEP) USING A CATHODE-LESS RF THRUSTER	357
<i>Raoul Andriulli, Shaun Andrews, Nabil Souhair, Mirko Magarotto, Fabrizio Ponti</i>	
PARAMETRIC INVESTIGATION OF A WATER-VAPOR HALL THRUSTER FOR 100W OPERATION	367
<i>Masayuki Matsuura, Kento Shirasu, Hiroyuki Koizumi, Yuichi Nakagawa, Hiroki Watanabe, Hokuto Sekine, Kimiya Komurasaki</i>	
LANTHANUM HEXABORIDE HOLLOW CATHODE FOR A MAGNETIC OCTUPOLE THRUSTER	376
<i>Jordan Hsieh</i>	

ELECTRIC PROPULSION (2)

NUMERICAL SIMULATION OF IONIC LIQUID ION SOURCES FOR ELECTROSPRAY PROPULSION DURING STEADY ION EVAPORATION	383
<i>Ximo Gallud Cidoncha, Paulo Lozano</i>	
DESIGN AND SIMULATION OF AN IONIC PROPULSION ENGINE WITH PROPOSED AU- GRAPHENE COMPOSITE MATERIAL.	384
<i>Rosaura Patricia Delgado Ortiz, Inri Yutlanitl Castellanos Urciaga, Rebeca Guadalupe Martinez Espejo, Viviana Itzel Cardona Ortiz, Jorge Emiliano Guerrero Rocha, Julio Abraham Rizo Churape, María Dolores Padilla Martín, Gerardo Pérez Mora</i>	
ASSESSMENT OF THE MPPT PROPELLANTS EVAPORATION CAPACITY CAUSED BY UV RADIATION.	386
<i>Evgenii Chebykin, Aleksei Pavlov, Tadeush Shchepanuk, Yury Yu. Protasov, Victor Telekh</i>	
DEVELOPMENT OF POWER PROCESSING UNIT FOR ELECTRICALLY PROPELLED SATELLITES	391
<i>Manju S. Nair, Jeena Varghese, Sunil Kumar S., Narayanan V</i>	
NOVEL COUPLING METHODS FOR FLUID AND KINETIC SOLVERS IN THE NUMERICAL MODELING OF HELICON PLASMA THRUSTERS	398
<i>Willem Van Lynden, Nabil Souhair, Raoul Andriulli, Shaun Andrews, Mirko Magarotto, Angelo Cervone, Fabrizio Ponti</i>	
THRUST LEVEL CHARACTERISTICS AT DIFFERENT XENON FLOW RATES	411
<i>Ilksen Burat, Yusuf Yurttas, Seda Kayra Gullu, Baris Cal</i>	
AMPSS-2.: ADVANCED MICRO-PROPULSION SYSTEM FOR SMALL SATELLITES BASED ON 2-MN HALL-EFFECT THRUSTER	417
<i>Merve Balaban, Norbert Pilz, Yulian Protsan, Vasyl Babytskiy, Andrei Mitrofanow, Taras Tymchenko</i>	
UNEXPECTED ELECTRICAL BREAKDOWN CHARACTERISTICS AND PROTECTION OF PPU IN SPACE ELECTRIC PROPULSION SYSTEM.	423
<i>Beifei Sheng, Siqiao Ge, Shuo Jiang, Xuan Zhang, Fengping He, Kang Li</i>	
HIGHLY EFFICIENT, MINIATURIZED POWER PROCESSING AND CONTROL UNIT (PPCU) FOR HALL EFFECT THRUSTERS (HET)	432
<i>Karthik Kumar Venkateshaiah, Kishan P V, Sahana Prasanna, Rohan M Ganapathy</i>	
FAR-FIELD PLUME CHARACTERIZATION OF IN-SITU 200W HALL EFFECT THRUSTER.....	433
<i>Vidhi Goyal, Meenakshee Sharma, Rajesh Natarajan, Rohan M Ganapathy</i>	

**HYPersonic AIR-BREATHING AND COMBINED CYCLE PROPULSION, AND
HYPersonic VEHICLE**

INVESTIGATION OF SHOCKS, BOUNDARY LAYER AND FUEL INJECTION
INTERACTION IN THE HIFIRE-2 SCRAMJET 434
*Sasi Kiran Palateerdham, Lakshmi Narayana Phaneendra Peri, Antonella Ingenito, Yash Pal,
Sri Nithya Mahottamananda*

INVESTIGATION ON COMBUSTION PERFORMANCE OF MACH 5 HYPersonic
RAMJET WITH SUBSONIC COMBUSTION 445
Mengze Qin, Peng Huang, Riheng Zheng, Caobin Chen

DESIGN AND STREAM THRUST ANALYSIS OF A MACH 8 SCRAMJET ENGINE WITH AN
AFTERBURNER BURNING METAL FUEL 457
Wang Xu, Haoming Wu, Jiaqi Yu, Xu Xu, Qingchun Yang

MULTI-OBJECTIVE DESIGN OPTIMIZATION OF SHOCK-INDUCED MIXING
ENHANCEMENT VIA EVOLUTIONARY ALGORITHMS ASSISTED BY DATA-DRIVEN
APPROACHES 470
Chihiro Fujio, Hideaki Ogawa

VOLUME 2

NUMERICAL ANALYSIS OF AEROSPIKE NOZZLES FOR AIR-BREATHING COMBINED
CYCLE PROPULSION ENGINES 485
Pratik B Matt, Vishal Hugar, Darpan Byahatti

EFFECT OF PLASMA SYNTHETIC JET ACTUATOR ON MIXING ENHANCEMENT IN A
SOLID-PROPELLANT DUCTED ROCKET 486
Yiqiao Zhang, Zhiwen Wu, Zhihui Zhang, Pengxin Chen, Baolu Shi, Xiaodong Chen

A STUDY ABOUT THE SIMPLE NUMERICAL SIMULATION METHODS TO ANALYZE THE
FLAME HOLDER FLOW FIELD OF THE HYPersonic JET ENGINES 493
Kotaro Iguchi, Masanori Harada, Hideki Moriai

EXPERIMENTAL STUDY ON FUEL SUPPLY CHARACTERISTICS OF MAGNESIUM
POWDER RAMJET ENGINE 501
Wang Xu, Qing Liu, Yang Qingchun, Xu Xu

EXPERIMENTS WITH HYDROGEN/AMMONIA MIXTURES FOR AIRBREATHING
HYPersonic PROPULSION 509
Subith Vasu

JOINT SESSION BETWEEN IAA AND IAF FOR SMALL SATELLITE PROPULSION SYSTEMS

ON-ORBIT PERFORMANCE OF AQUARIUS: WORLD'S FIRST SUCCESSFUL WATER PROPULSION SYSTEM IN DEEP SPACE	513
<i>Isamu Moriai, Hokuto Sekine, Yasuho Ataka, Aoma Fujimori, Mariko Akiyama, Masaya Murohara, Hiroyuki Koizumi, Naoto Aizawa, Ten Arai, Yuto Tsuchiya, Mizuki Noguchi, Masayuki Matsuura, Hiroki Kuwabara, Rucheng Zhang, Jotaki Yuki, Ryo Minematsu, Kento Shirasu, Daigo Takasaki, Kota Kakiyama, Shuhei Matsushita, Toshihiro Shibukawa, Shingo Nishimoto, Kazuki Toma, Shunichiro Nomura, Toshihiro Suzuki, Hirotaka Sekine, Yosuke Kawabata, Masairo Fujiwara, Kentaro Enokida, Tomoki Mochizuki, Takuya Chikazawa, Shintaro Nakajima, Ryota Fuse, Kota Miyoshi, Akihiro Ishikawa, Satoshi Ikari, Ryu Funase</i>	
DEVELOPMENT OF A NOVEL AMBIPOLAR PLASMA THRUSTER FOR NANOSATELLITES AND AIR BREATHING APPLICATIONS	521
<i>Christoph Peter, Martin Tajmar</i>	
IANUS: AN OVERVIEW ON THE TESTING CAMPAIGN OF THE MILANI PROPULSION SYSTEM	536
<i>Brunella Montanari, Matteo Gerbino, Riccardo Mantellato, Fabiana Milza, Elena Toson, Daniele Pavarin, Margherita Cardi, Marco Pavoni, Alessia Basler, Franco Perez Lissi, Pedro Herraiz Alijas</i>	
DEVELOPMENT OF A 50 W POROUS EMITTER ELECTROSPRAY THRUSTER TOWARDS FLIGHT	546
<i>Arsad Quraishi, Szymon Dworski, Emmanuel Batchelor, Alejandro Gonzalez Machado, Charles N. Ryan, Alessandro Ferreri, Guillaume Vincent, Albin Croos, Alberto Garbayo, Mária Vozárová, Erich Neubauer</i>	
UNISAT-8: A STABLE SATELLITE FORMATION USING ELECTRIC PROPULSION	562
<i>Filippo Graziani, Stefano Carletta, Norbert Pilz, Yulian Protsan</i>	
DEMONSTRATION OF THE FULLY WIRELESS THRUST MEASUREMENT SYSTEM FOR MICROPROPULSION	569
<i>Ten Arai, Isamu Moriai, Hokuto Sekine, Hiroyuki Koizumi, Kimiya Komurasaki</i>	
STUDY, DEVELOPMENT, IMPLEMENTATION AND TESTING OF A WATER RESISTOJET PROPULSION SYSTEM FOR CUBESATS	576
<i>Federico Larizza, Paolo Marzioli, Fabrizio Piergentili, Mario Tindaro Migliorino, Francesco Nasuti</i>	
POLYMERS THRUST CHARACTERISTICS IN ABLATIVE PULSED PLASMA MICROTHRUSTER	589
<i>Daria Fedorova, Anastasia Podlosinskaya, Vladimir Skorniyakov, Denis Egoshin, Aleksei Pavlov, Victor Telekh</i>	
EXPERIMENTAL CHARACTERIZATION OF AN IMPULSIVE HYDROGEN PEROXIDE-BASED ROCKET FOR FINE ORBIT CONTROL	596
<i>Sergio Cassese, Stefano Mungiguerra, Riccardo Guida, Raffaele Savino</i>	
DESIGN AND DEVELOPMENT OF A BUTANE WARM GAS PROPULSION SYSTEM FOR 6U CUBESAT;	606
<i>Djamal Darfilal</i>	

3D PRINTED MINIATURIZED MICRO THRUSTERS FOR CUBESAT APPLICATIONS	607
<i>Sasi Kiran Palateerdham, Karthika Regunatha Perumal, Antonella Ingenito, Roberto Andriani, Mauro Panzanaro, Lakshmi Narayana Phaneendra Peri</i>	

QUALIFICATION CAMPAIGN FOR A CENTRE-TRIGGERED PULSED CATHODIC ARC THRUSTER	614
<i>Patrick Neumann, Hamza Baig, Steven Despotellis, J M Mostert</i>	

THERMALLY DECOMPOSED HYDROGEN PEROXIDE FOR SMALL SCALE MONOPROPELLANT PROPULSION APPLICATION.....	623
<i>Adil Mahroof, Rashid Albraiki, Abdulla Abulhassan, Mohamed Elawad, Jeongmoo Huh</i>	

DISRUPTIVE PROPULSION CONCEPTS FOR ENABLING NEW MISSIONS

KEYNOTE: SPACE FLIGHT EXPERIMENTS OF DETONATION ENGINE SYSTEM BY USING SOUNDING ROCKET S-520.....	626
<i>Jiro Kasahara</i>	

QUANTUM PROPULSION FOR INTERSTELLAR TRAVEL: ANALYSIS AND EXPLORATION OF KEY CHALLENGES	633
<i>Pratyaksha Shetty, Huda Mohammad, Shambhavi A S</i>	

ATMOSPHERE-BREATHING ELECTRIC PROPULSION (ABEP) SYSTEM USING A CATHODE-LESS RF PLASMA THRUSTER: DESIGN AND ROBUST OPTIMISATION FOR VLEO	644
<i>Shaun Andrews, Raoul Andriulli, Nabil Souhair, Mirko Magarotto, Fabrizio Ponti</i>	

APPLICATION OF NUCLEAR THERMAL PROPULSION FOR SUSTAINABLE CISELUNAR EXPLORATION	657
<i>Saroj Kumar</i>	

INTEGRATED OPTIMIZATION OF SPACECRAFT LAYOUT AND SCENARIOS FOR LONG-TERM MAINTENANCE OF ELLIPTICAL ORBITS WITH ULTRA-LOW PERICENTERS USING ONLY RENEWABLE RESOURCES	665
<i>Alexander S. Filatyev, Alexander Golikov, Elena Kralkina, Vasily Sazonov, Konstantin Vavilin</i>	

FEASIBILITY OF HYBRID PHOTONIC PROPULSION TECHNOLOGY(HOPT) FOR FUTURE SPACE MISSION	676
<i>Anand Nagesh</i>	

EFFICIENCY EVALUATION OF EMITTED CHARGED DROPLETS IN ULTRASONIC-ASSISTED ELECTRIC PROPULSION SYSTEM	677
<i>Weiguo He, Weijie Huo, Feng Wang, Shunqi Zhang</i>	

THE CASE STUDY OF ADVANCED NUCLEAR PROPULSION METHODS FOR INTERSTELLAR UNMANNED PROBE TO ALPHA CENTAURI	685
<i>Ugur Guven, Gurunadh Velidi</i>	

OPTIMAL DESIGN AND CURRENT CONTROL STRATEGIES OF AN ELECTRODYNAMIC TAPE FOR ISS STATION-KEEPING	691
<i>Alice Brunello, Gabriel Borderes-Motta, Sadaf Shahsavani, Andrea Valmorbida, Gonzalo Sánchez-Arriaga, Enrico C. Lorenzini</i>	

**JOINT SESSION ON NUCLEAR POWER AND PROPULSION SYSTEMS, AND
PROPELLANTLESS PROPULSION**

KEYNOTE: NUCLEAR THERMAL PROPULSION – PROGRESS AND POTENTIAL..... 702
Dale Thomas

DEPLOYMENT OF THE LARGE SIZE SOLAR SAIL 715
Roman Ya. Kezerashvili, Vladimir Ya. Kezerashvili

ADAPTIVE ORBIT DESIGN AND CONTROL OF SOLAR SAILS IN COMPLEX AND
UNCERTAIN SPACE ENVIRONMENTS 716
Zhuoqing Yao, Shengping Gong, Shi Peng, Yuying Liang, Jixin Ding

APPLICATION OF NUCLEAR POWER AND PROPULSION SYSTEMS OF HIGH POWER
LEVEL FOR SPACE TRANSPORTATION 731
*Vladimir Koshlakov, Nikolay Arkhangelsky, Andrey Karevskiy, Ekaterina Kuvshinova, Evgeny
Muzychenko, Alexander Semekin, Alexey Sinitsin, Alexander Solodukhin, Leonid
Zakharenkov*

LAYOUT OPTIMIZATION AND UNLOADING STRATEGY FOR SOLAR SAILS USING
REFLECTIVITY CONTROL DEVICE 740
Xuanchi Qi, Caizhi Fan, Guanwei He

RECENT PROGRESS ON NUCLEAR FUEL TESTING CAPABILITIES IN THE MIT
REACTOR FACILITY 749
Roger X. Lenard

APPLICATION OF THE RELIABILITY-DRIVEN DESIGN AND TEST METHODOLOGY TO
NUCLEAR THERMAL PROPULSION SYSTEMS 757
Samantha Rawlins

DEVELOPMENT OF A HIGH POWER NUCLEAR ELECTRIC PROPULSION SYSTEM FOR
INTERPLANETARY MISSIONS..... 774
*Charlie Ryan, Vlad-George Tirila, James Lambert, Richard Dinan, Dave Malley, Tauseef
Syed, Nathaniel Reed, Eugene Shwageraus, Thomas Munro-O'Brien, Benjamin Negre,
Alexander Wittig*

RESEARCH PROGRESS TOWARD ENGINEERING FEASIBILITY OF THE CENTRIFUGAL
NUCLEAR THERMAL ROCKET 787
*Dale Thomas, Michael Houts, Dean Wang, Keith Hollingsworth, Robert A. Frederick, Jr.,
Jason Cassibry*

SYSTEM DESIGN OPTIMIZATION FOR A CENTRIFUGAL NUCLEAR THERMAL ROCKET..... 799
Mitchell Schroll

SUB-SCALE DEMONSTRATION OF AN AXIAL PULSED MAGNETIC NOZZLE FOR
NUCLEAR PROPULSION SYSTEMS 808
Nathan Schilling, Naoji Yamamoto, Taichi Morita, Hideki Nakashima, Jason Cassibry

INTERACTIVE PRESENTATIONS - IAF SPACE PROPULSION SYMPOSIUM

ROLE OF ACOUSTICS ON UNSTABLE FIRE PHENOMENON IN SPACE PROPULSION 816
Vinayak Malhotra, Gautam Kumar

RESEARCH ON THE ACOUSTIC CHARACTERISTICS OF FLOW DISTRIBUTION PLATE IN LOX/KEROSENE STAGED COMBUSTION ROCKET ENGINE.....	817
<i>Chen Cao, Yang Yongqiang, Yonghua Tan, Chen Jianhua, Yunhao Liu</i>	
REVIEW ON THE TECHNOLOGY OF LIQUID OXYGEN KEROSENE ENGINE FOR THE BOOSTER STAGE OF LONG MARCH 5.....	823
<i>Chen Jianhua, Yang Yongqiang, Chen Cao, Nan Ma, Yiyao Wang</i>	
FUSION-ENABLED PLASMA PROPULSION FOR ENABLING INTERSTELLAR MISSIONS.....	830
<i>Ravinder Singh</i>	
FABRICATION AND PROPULSION PERFORMANCE TESTING OF A 100 MN CLASS RESISTOJET THRUSTER	831
<i>Mohamed Elawad, Abdulla Abulhassan, Rashid Albraiki, Adil Mahroof, Jeongmoo Huh</i>	
SIDEWALL-MOUNTED PLANAR TYPE PROPULSION SYSTEM FOR POST MISSION DISPOSAL OF CUBESATS	835
<i>Daeban Seo, Sungmoon Lee, Jaesung Park</i>	
MAGNETIC OCTUPOLE PLASMA THRUSTER WITH A CENTER-MOUNTED HOLLOW CATHODE	840
<i>Jordan Hsieh</i>	
DIRECT THRUST MEASUREMENTS OF MULTIDIRECTIONAL PLASMA THRUSTER OPERATED IN KRYPTON	847
<i>Andrei Shumeiko, Victor Telekh</i>	
ADVANCED ROOM TEMPERATURE PROPELLANTS FOR ROCKETS AND SPACECRAFTS	854
<i>Ansh Jaipuria</i>	
ENERGETIC AND SUSTAINABLE ROCKET PROPELLANT FOR LOWER STAGE	861
<i>Bhushan Thomabre, Saumya Shekhar</i>	
EXPERIMENTAL STUDY ON OXYGENATION CONSTANT VOLUME COMBUSTION CHARACTERISTICS OF HYDROGEN INTERNAL COMBUSTION ENGINE.....	862
<i>Xia Zhang, Baigang Sun, Shengbao Wu, Shuting Wang, Liqiang Ai</i>	
MAGNETICALLY LEVITATED TEST STAND FOR THRUST MEASUREMENT FOR MICRO PROPULSION SYSTEMS	869
<i>Basel Altawil</i>	
THE EFFECT OF SWIRL INJECTION PARAMETERS ON A VORTEX-COOLED THRUSTER FABRICATED USING THERMOPLASTICS AND METAL	870
<i>Mousa Aqailan, Jeongmoo Huh</i>	
RENEWABLE LIQUID PROPELLANTS: DECARBONIZING SPACE EXPLORATION.....	877
<i>Nazim Muradov, James Fenton</i>	
RESEARCH PROGRESS AND FUTURE PROSPECTS OF NOVEL LIQUID PROPELLANT	884
<i>Xing Zhang, Wei Xue</i>	
DEVELOPMENT OF ATLAS: A LIQUID ROCKET ENGINE CRYOGENIC TEST STAND AND FEED SYSTEM	891
<i>Johannes Reichert, Jaayden Thomas, Camila Aristimuno, Armen Aroutiounian, Danetti Martino, Francisco Razo</i>	

COMPUTATIONAL SIMULATION OF BORON OXIDATION BY ATMOSPHERIC AIR OXYGEN USING REACTIVE MOLECULAR DYNAMICS.....	897
<i>José Rocco, Marcela Galizia Domingues, Daniel Bontorin, Rene Gonçalves, Marina T, Démerson Ferreira</i>	
OVERVIEW OF EXISTING LAUNCH VEHICLE FUEL TANK PRESSURIZATION SYSTEMS AND DEVELOPMENT PROSPECTS	903
<i>Vadym Khomiak, Anatoly Logvinenko</i>	
A TRADE STUDY OF MISSION ARCHITECTURES FOR CENTRIFUGAL NUCLEAR THERMAL PROPULSION	904
<i>William Ziehm, Dale Thomas</i>	
TOOLKIT FOR LIQUID ROCKET PROPULSION SYSTEM DESIGN	910
<i>Nijat Abdulla</i>	
DESIGN EVALUATION OF THE PERFORMANCE CAPABILITIES AND SCHEMATIC FOR THE LOX/LNG LIQUID-PROPELLANT ROCKET ENGINE	920
<i>Volodymyr Shulha, Alexandr Prokopchuk, Sergey Shokod'Ko, Dmytro Khromiuk</i>	
A NEW H ₂ O ₂ ORIENTED ROCKET AND SATELLITE PROPULSION LABORATORY CENTER	921
<i>Lukasz Radzikowski, Adam Okninski, Cezary Chmielewski, Jan Kierski, Konrad Wojciechowski, Wioleta Kopacz, Cezary Kostrzewski, Rafal Sikorski</i>	
USING THE INTRINSIC MAGNETIC SUSCEPTIBILITY CHANGE OF METHANE COMBUSTION TO INCREASE MANEUVERABILITY OF RCES	936
<i>Akash Prasanna, R Tharunika, Anagha Udupa, Syed Muzzammil, Ronit Singh, Shaifali Arora</i>	
NUMERICAL SIMULATION OF A DETONATION ENGINE.....	937
<i>Elena Mikhalchenko, Valeriy Nikitin, Evgeniya Skryleva</i>	
POWER CONVERTER WITH HIGH GAIN, HIGH PERFORMANCE FOR SPACE THRUSTERS BASED ON ELECTROSPRAY TECHNOLOGY.....	942
<i>Francisco José Blázquez Plaza</i>	
GREEN PROPELLANTS: SELF-PRESSURIZATION BEHAVIOR MODELLING	943
<i>Simone La Luna, Davide Zuin, Filippo Maggi</i>	
EXPLORING THE COMPLEXITIES OF PINTLE INJECTORS FOR HIGH PERFORMANCE ROCKET PROPULSION AN ADVANCED NUMERICAL SIMULATION INVESTIGATION WITH EXPANSION DEFLECTION NOZZLE	948
<i>Sudarsan Nerella, Aakash Preetham</i>	
REPORT ON TEST FIRING RESULTS OF 6.5 KN PRESSURE-FED HYPERGOLIC STORABLE LIQUID ROCKET ENGINE AND COMPARISON TO THE DESIGN THEORETICAL CALCULATIONS.....	949
<i>Florin Mingireanu</i>	
STRUCTURAL MODIFICATION AND FLOW ANALYSIS OF ISOLATOR FOR ENHANCED EFFICIENCY OF DUAL MODE RAMJET-SCRAMJET ENGINE	950
<i>Greekshith Mahesh Babu, Solomon D'Costa, Satej Patil, Chyawan Chandrashekar, Vageesha Sharma</i>	

LATE BREAKING ABSTRACTS (LBA)

GRAPHENE-BASED LASER PROPULSION FOR SPACE APPLICATION 951
Omnia Khattab

Author Index